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GB 2122725 A WO 1997/008472 A
DE 019531190 A

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(54) Abstract Title
Torsional vibration damper

(57) A device for isolating fluctuations in drive torque of a rotary drive shaft to a pulley comprising first 2 and second 3 members for connection to drive shaft and driven member respectively and an annular, externally hexagonal resilient member 22 interposed between the first and second members which has apertures 27 each containing a sleeve 28, wherein a first aperture receives a projection 30 connected to the first member and a second of said apertures receives a projection 31 connected to the second member. In use the resilient member is compressed between the projections which may be studs or integral with the respective member formed by cutting and bending (150, 151 Fig. 3). The first member has an axial ring 7 carrying an inertia member 16 via an elastomeric layer 19 and there are PTFE or nylon tape bearings 11, 18, 20 between the parts.

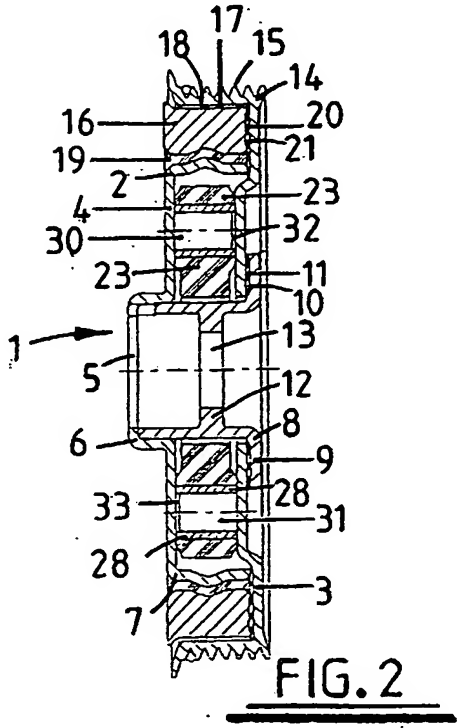

FIG. 2

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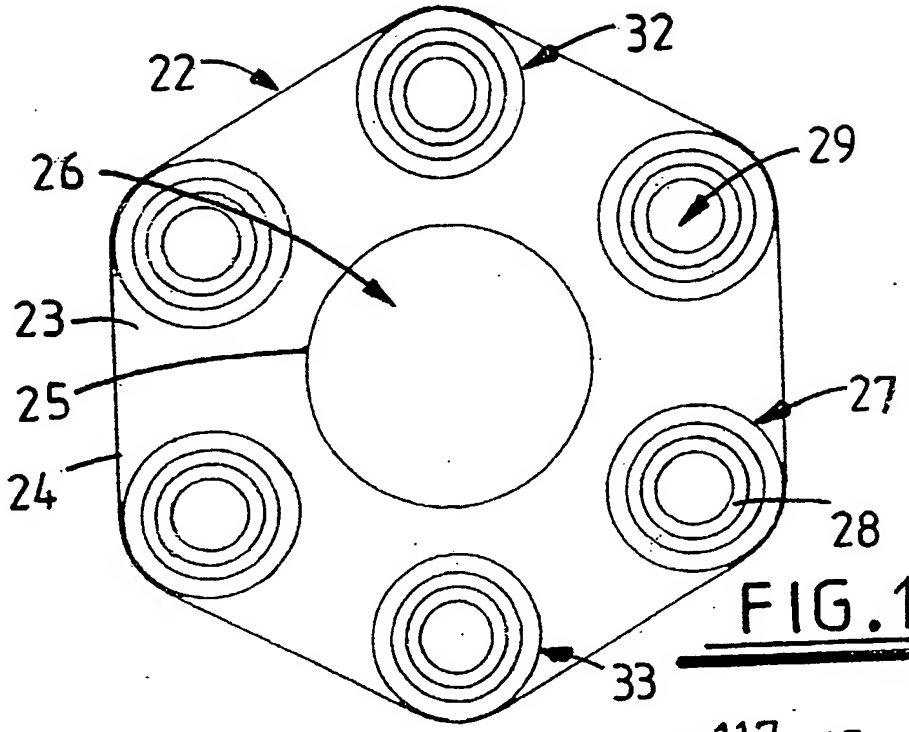

FIG.1

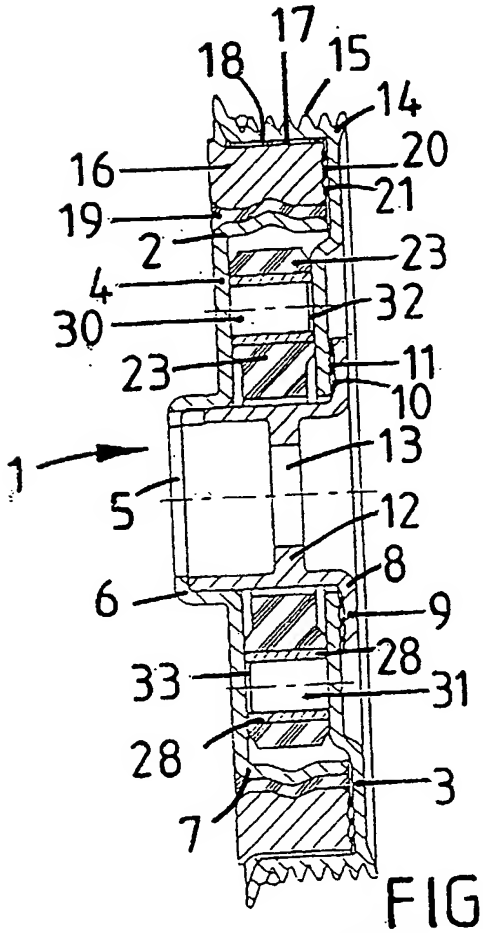

FIG.2

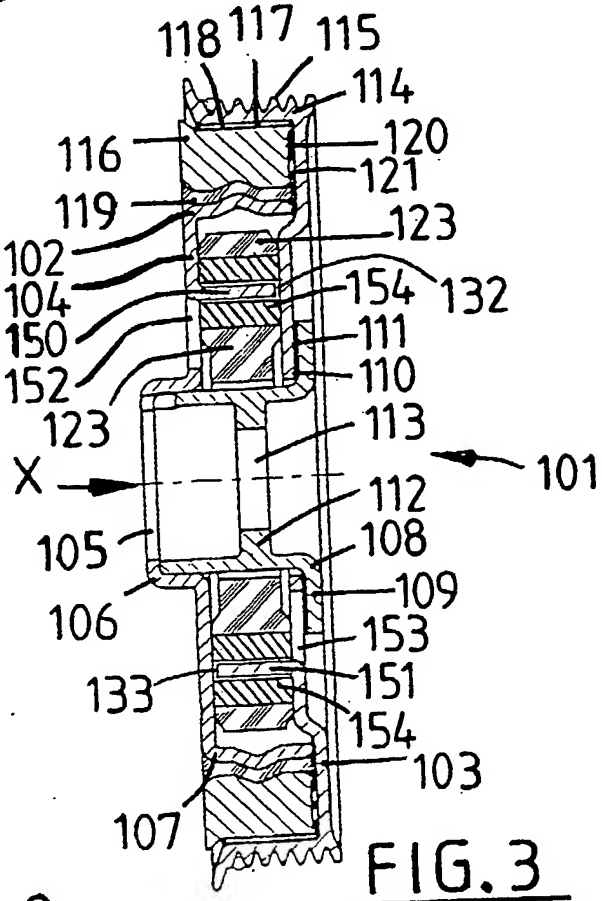

FIG.3

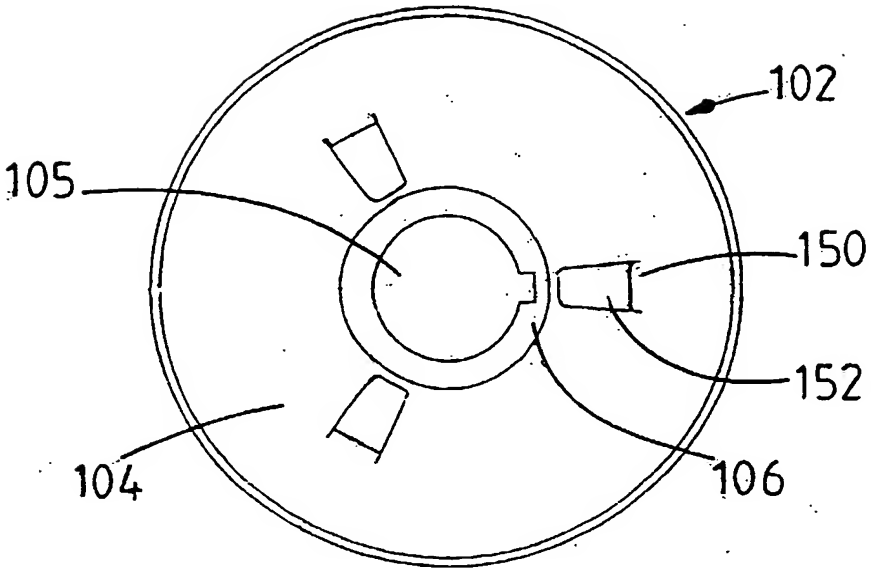

FIG.4

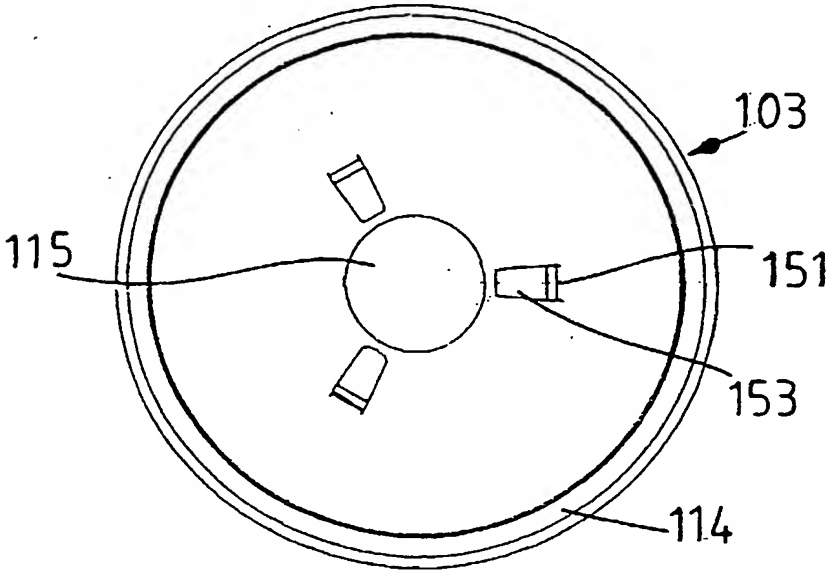

FIG.5

A DEVICE FOR ISOLATING TORQUE FLUCTUATIONS

The present invention relates to a device for isolating fluctuations in torque and more particularly to such a device for isolating fluctuations in the drive torque of a drive shaft.

Such devices are well known and are often mounted on the crankshaft of the internal combustion engine of a motor vehicle so that it can drive a driven component such as an alternator, a fan or other piece of equipment. Devices of this type are often fitted with a torsional vibration damper in the form of an annular inertia member mounted on an elastomeric material.

One example of a device of this kind is disclosed in European Patent No. EP808431. This document describes a drive device comprising a primary element connected to the drive shaft and a secondary element having a contoured pulley rim to which a V-belt drive is attached. The belt transmits power from the drive shaft to a driven component. The primary and secondary elements are interconnected by a torsionally flexible elastic ring which is loaded in shear and effectively absorbs rotational fluctuations in the motion of the driven shaft so that they are not transmitted to the driven component. Torsional vibrations of the shaft to which the device is attached are damped by means of an inertia ring connected to the primary element by means of an elastic element.

One disadvantage of a device of this type is that the primary and secondary elements are subject to a relatively large relative rotational displacement during initial loading before the drive torque is transmitted to the load through the torsionally flexible elastic ring. Moreover, if the torsionally flexible elastic ring should fail through age or excess loading the coupling provides no drive connection between the driving shaft and the driven member. A further disadvantage is that the torsionally flexible elastic ring is loaded in shear as in all devices of this kind. Elastomeric materials exhibit poor physical characteristics when loaded in shear and have a tendency to wear and/or fail.

A further example is disclosed in European Patent No. EP898665. In this case the first and second members are interconnected by a plurality of elastomeric elements which are pre-compressed in a circumferential direction between retaining plates fixed to the first and second members. Pre-compression of the elastomeric elements permits a minimum torque of the drive

shaft for a nominal torque level to be transmitted to the driven member load substantially without deflection of the elastomeric element.

A disadvantage of the invention disclosed in EP898665 is the undesirable noise level produced during operation by the retaining plates knocking against one of the annular members. A further disadvantage of this device is the requirement to bond the retaining plates to the elastomeric elements, which substantially increases both the complexity and cost of production.

It is an object of the present invention to obviate or mitigate the aforesaid disadvantages.

According to the present invention there is provided a device for isolating fluctuations in torque of a rotary drive shaft, the device comprising a first member for connection to the drive shaft, a second member for connection to a driven member and a resilient member interposed between the first and second members so as to be compressed in a circumferential direction relative to the drive shaft when the drive shaft is applying torque to the driven member; the resilient member having at least two apertures extending substantially axially relative to the drive shaft, wherein a first of said apertures receives a projection connected to the first member and a second of said apertures receives a projection connected to the second member.

Driving the resilient member in this way, i.e. in tension and compression rather than in shear, reduces the tendency for this component to wear and/or fail.

Preferably, an inertia member is connected to the first member. The inertia member may be disposed in a housing containing a viscous or elasticoviscous fluid, the housing being connected to the first member.

A radial bearing may conveniently be provided between a rim of the second member and the inertia member.

The projection may conveniently be in the form of a cylindrical stud or may be formed by cutting and bending a section of the annular member to which it is connected. The projection may be formed integrally with the member to which it is connected.

The resilient member preferably has a plurality of apertures and is preferably formed from an elastomeric material. Preferably the resilient member is substantially annular and the apertures may be equi-angularly spaced. Conveniently, the resilient member may be interposed between a hub member and a substantially axially extending peripheral ring of the first member.

There may be provided an axial bearing in an axial clearance between the first and second members.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a front view of the resilient member forming part of the device of the present invention;

Figure 2 is a sectioned side view of the device of the present invention;

Figure 3 is a sectioned side view of an alternative embodiment of the device of the present invention;

Figure 4 is a front view of a first annular member of the device of figure 3 looking in the direction of arrow X; and

Figure 5 is a front view of a second annular member of the device of figure 3 looking in the direction of arrow X.

Referring now to figures 1 and 2, the device 1 comprises concentric first and second annular members 2, 3. The first annular member 2 is designed to connect to a rotary drive shaft (not shown) for example the crankshaft of an internal combustion engine of a motor vehicle. The second annular member 3 is designed to connect to a driven auxiliary component such as an alternator, a fan or other piece of equipment so that the engine can drive the driven equipment.

The first annular member 2 comprises a disc 4 with a central aperture 5 for receiving the rotary shaft. The disc 4 has a central portion 6 extending substantially parallel to the rotational axis of the drive shaft and, at its radially outer periphery, a ring 7 extending in the axial direction. On its

radially inner surface, the central portion 6 is fixed to one end of a hub member 8. The hub member 8 is generally cylindrical with a radially outward extending flange 9 opposite the end where it is fixed to the central portion 6. The flange 9 extends radially over part of the axially outer surface of the second annular member 3 with an axial clearance 10 in which a low friction bearing 11, such as PTFE or nylon tape, is disposed so as to act as an axial guide bearing. The hub member 8 additionally comprises a radially inward extending ring 12 with a central aperture 13 to receive the drive shaft (not shown).

The second annular member 3 comprises a peripheral pulley rim 14 which extends in a direction substantially parallel to the rotational axis of the drive shaft. The radially outer surface of the pulley rim 14 has a V-groove configuration 15 designed to receive a drive belt having a complementary V-groove configuration. The drive belt is used to drive auxiliary equipment. Alternative embodiments of the surface of the pulley rim may be provided (not shown) for example chain sprockets to receive a chain drive. The pulley rim 14 extends over the radially outer surface of an inertia member 16 with a radial clearance 17 in which a low friction bearing 18, such as PTFE or nylon tape, is placed so as to act as a radial guide bearing for the pulley rim 14.

The peripheral ring 7 of the first annular member 2 supports, on its radially outer surface, the annular inertia member 16 which is fixed thereto by means of an intermediate elastomeric layer 19. This arrangement is well known and acts to dampen torsional vibrations of the drive shaft. In an alternative embodiment (not shown), the elastomeric layer 19 may be replaced with a viscous or elasticoviscous fluid contained within a ring-shaped housing in which the inertial member is disposed. A low friction bearing 20, such as PTFE or nylon tape, is placed in an axial clearance 21 between the axially outer surface of the inertia member 16 and the axially inner surface of the second annular member 3 so as to act as an axial guide bearing. The physical characteristics of the inertia member 16, the elastomeric layer 19 and the low friction bearing 20 are selected according to the degree of damping required for a particular combination of drive shaft and driven member.

An annular resilient member 22 is disposed between the first and second annular members 2, 3. Resilient member 22 comprises an annular elastomeric ring 23 with a hexagonal outer periphery 24 and circular inner periphery 25 defining a central opening 26 to receive the hub member 8, and a plurality of equi-angularly spaced apertures 27 each having a concentric inner sleeve 28

and a central aperture 29. Each sleeve 28 may be manufactured from any suitable material e.g. plastic, and is configured to receive an axially projecting cylindrical stud 30 that is fixed to the first annular member 2, or an identical stud 31 that is fixed to the second annular member 3. The studs 30, 31 may be fixed to annular members 2, 3 by any convenient means, for example, welding, or may be formed integrally with the annular member to which they are connected. In the embodiment of figures 1 and 2 the device is arranged so that studs 30 and 31 are received in diametrically opposite apertures for example 32 and 33 respectively.

When in use, the drive shaft applies a torque to the first annular member 2 via the hub member 8. The torque is transferred from the first annular member 2 to the second annular member 3 via the resilient member 22. The resilient member 22 is disposed between the first and second annular members 2, 3 so as to be compressed in a circumferential direction relative to the drive shaft when a torque is being transferred, thereby isolating any fluctuations in torque and preventing their transmission to the second annular member 3 (and therefore the belt and the driven members).

An alternative embodiment of the present invention is shown in figures 3, 4 and 5 in which parts corresponding to those shown in figures 1 and 2 are indicated with the same reference numeral but increased by 100 and are not further described except insofar as they differ from their counterparts in figures 1 and 2. In this embodiment studs 30, 31 have been replaced with projections 150, 151. Projections 150, 151 have been formed by cutting out equi-angularly spaced sections of the face of the annular member 102, 103 to which it is connected and bending each section through approximately 90°, thereby forming apertures 152, 153. In the arrangement shown in figures 3, 4 and 5, projection 150 is formed integrally with the first annular member 102 and projection 151 is formed integrally with the second annular member 103. Projections 150, 151 extend in a direction substantially parallel to the rotational axis of the drive shaft and each is received in a sleeve 154 of the resilient member 22. This alternative type of sleeve 154 is used in place of the sleeves 28 shown in figures 1 and 2 and, as before, can be manufactured from any convenient material, e.g. plastic. Each sleeve 154, suitable to receive the projections 150, 151 formed by cutting and bending sections of the face of the annular member 102, 103, has a circular outer edge, substantially identical to the sleeve 28, and an inner edge formed as a slit suitable to receive each projection 150, 151.

It will be understood that numerous modifications to the above described designs may be made without departing from the scope of the invention as defined in the appended claims. For example, the first annular member may be fitted to the rotary drive shaft by any suitable means such as a key, spline or shrink connection. In addition, the presence of the inertia member is optional and the low friction bearings may be manufactured from any suitable material.

The shape of the resilient member may take any convenient annular form, in addition to that shown in figure 1. For example, the radially innermost and outermost edges of the resilient member may both be circular when viewed along the axis of rotation of the drive shaft, as in figure 1. The choice of the material from which the resilient member is manufactured should be such that it can stretch and compress in a circumferential direction sufficiently to enable torque fluctuations to be isolated so that they are not passed on to a pulley and the driven components.

CLAIMS

1. A device for isolating fluctuations in torque of a rotary drive shaft, the device comprising a first member for connection to the drive shaft, a second member for connection to a driven member and a resilient member interposed between the first and second members so as to be compressed in a circumferential direction relative to the drive shaft when the drive shaft is applying torque to the driven member; the resilient member having at least two apertures extending substantially axially relative to the drive shaft, wherein a first of said apertures receives a projection connected to the first member and a second of said apertures receives a projection connected to the second member.

2. A device according to claim 1, wherein an inertia member is connected to the first member via an elastomeric element.

3. A device according to claim 1, wherein an inertia member is disposed in a housing containing a viscous or elasticoviscous fluid, the housing being connected to the first member.

4. A device according to claim 2 or 3, wherein a radial bearing is provided between a rim of the second member and the inertia member.

5. A device according to any preceding claim, wherein the projection is in the form of a cylindrical stud.

6. A device according to any one of claims 1 to 4, wherein the projection is formed by cutting and bending a section of the annular member to which it is connected.

7. A device according to any preceding claim, wherein the projection is formed integrally with the member to which it is connected.

8. A device according to any preceding claim, wherein the resilient member has a plurality of apertures.

9. A device according to any preceding claim, wherein the resilient member is formed from an elastomeric material.

10. A device according to any preceding claim, wherein the resilient member is substantially annular.

11. A device according to any preceding claim, wherein the apertures are equi-angularly spaced.

12. A device according to any preceding claim, wherein the resilient member is interposed between a hub member and a substantially axially extending peripheral ring of the first member.

13. A device according to any preceding claim, wherein there is provided an axial bearing in an axial clearance between the first and second members.

14. A drive assembly comprising a rotary drive shaft connected to a driven member via a device according to any preceding claim.

15. A device substantially as hereinbefore described with reference to the accompanying drawings.

INVESTOR IN PEOPLE

Application No: GB 0108437.5 **Examiner:** J. C. Barnes-Paddock
Claims searched: 1-15 **Date of search:** 15 August 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): F2U

Int Cl (Ed.7): F16D 3/62, 68, 78; F16F 15/124, 126, 136; F16H 55/14

Other: Online: WPI EPODOC PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2122725 A	(DAIKIN) See Figures 2 and 3. Shock absorbers with springs and terminal apertures for studs/pins 16, 17.	1,5,8,11
X	WO9708472 A	(SGF) See Figure 1. Coupling with axis parallel projections, annular connecting member and inertia mass.	1,2,5 8-11, 14
X	DE19531190	(SGF) See Figure 1. Coupling with axis parallel projections, annular connecting member and inertia mass.	1,2,5 8-11, 14

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.